



Subject card

Subject name and code	Nanotechnology in autonomous power supply systems, PG_00071222						
Field of study	Nanotechnology						
Date of commencement of studies	February 2027	Academic year of realisation of subject			2027/2028		
Education level	second-cycle studies	Subject group			Specialty subject group Subject group related to scientific research in the field of study		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	1	Language of instruction			Polish		
Semester of study	2	ECTS credits			3.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Division of New Functional Materials For Energy Conversion -> Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Beata Bochentyn					
	Teachers	dr hab. inż. Beata Bochentyn					
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	0.0	0.0	45
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM		
	Number of study hours	45	2.0	28.0	75		
Subject objectives	The course aims to present the role of nanotechnology in the design, integration, and evaluation of energy sources and storage systems for autonomous power systems. Particular emphasis is placed on nanoscale energy conversion and storage mechanisms, nanostructured functional materials (electrodes, catalysts, active layers), and stability and reliability of operation across a wide range of temperatures and environmental conditions. This course prepares students to understand and design hybrid, self-sufficient energy systems based on batteries, supercapacitors, photovoltaics, fuel cells, thermoelectrics, and hydrogen technologies.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W01] has broadened and well-structured knowledge in the field of materials science, including material fabrication or control of processes accompanying fabrication, with particular emphasis on materials and structures at the nanoscale.	The student has structured and advanced knowledge of materials and nanoscale structures used in autonomous power supply systems, including their fabrication as well as energy conversion and storage processes.	[SW1] Assessment of factual knowledge
	[K7_W03] has knowledge of current development trends and the latest discoveries in the fields of physics, chemistry, technology, and applications of nanostructures	The student has knowledge of current development trends and the latest achievements in the physics, chemistry, and technology of nanostructures used in energy conversion and storage, including advances in the design of functional nanomaterials (electrodes, catalysts, active layers) for batteries, supercapacitors, photovoltaics, fuel cells, hydrogen technologies, and thermoelectrics, as well as contemporary challenges related to their stability and reliability under varying environmental conditions.	[SW1] Assessment of factual knowledge
	[K7_U06] is able to apply acquired specialist knowledge to problems in other physical, natural, or technical sciences and to critically analyze and evaluate the functioning of the adopted solutions	The student is able to apply specialist knowledge in nanotechnology and materials engineering to the planning and execution of laboratory experiments on nanoscale energy conversion and storage systems, to analyze and interpret measurement results, and to carry out a critical evaluation of the performance of the investigated solutions with respect to efficiency, stability, and operating conditions.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task [SU3] Assessment of ability to use knowledge gained from the subject
Subject contents	<p>Course content – lecture</p> <ol style="list-style-type: none"> 1. Nanotechnology in Autonomous Energy Systems Introduction 2. Nanoscale Energy Storage Mechanisms 3. Electrode Nanostructures for Zn Batteries 4. Nanostructure-Based Supercapacitors 5. Nanostructures in Photovoltaic Cells 6. Nanotechnology in Fuel Cells 7. Nanotechnologies in Hydrogen Energy 8. Nanostructures in Thermoelectrics 9. Stability of Energy Sources at Variable Temperatures 10. Integration and Hybridization of Energy Sources <p>Course content – laboratory</p> <p>In laboratory classes, students will examine model energy storage systems, determine their efficiency, and investigate their stability under various operating conditions. They will also learn about the impact of nanostructuring on the operating parameters of fuel cells, batteries, and thermoelectric devices.</p>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Written exam	50.0%	50.0%
	Lab Task Reports	100.0%	50.0%
Recommended reading	Basic literature	<p>Odnawialne źródła energii. Red. Wichliński, Michał. Częstochowa: Politechnika Częstochowska, 2021, 152 s. ISBN 978-83-7193-867-2</p> <p>Nanostructured Materials for Next-Generation Energy Storage and Conversion, ed. Ying-Pin Chen, Sajid Bashir, Jingbo Louise Liu, Springer 2017</p> <p>Nanomaterials for Energy Storage Systems - Review, Habeeb Mohammed et al., Molecules 2025, 30, 883</p>	

	Supplementary literature	Maier J. Nanoionics: ion transport and electrochemical storage in confined systems. Nat Mater. 2005 Nov;4(11):805-15. doi: 10.1038/nmat1513. PMID: 16379070.
	eResources addresses	
Example issues/ example questions/ tasks being completed	<p>Suggest a device and the materials it could be made from to power:</p> <p>a) a drone b) an autonomous vehicle c) a system for heating water and food on the battlefield. Will the use of nanostructures affect the operation of these devices, and if so, how?</p> <p>Determine the efficiency, operating parameters and long-term stability of the selected energy conversion device.</p>	
Practical activities within the subject	Not applicable	

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